Contents

1. Product Overview

R60-AL is a high-performance digital stepper motor driver with integrated intelligent motion controller function and built-in S-shaped acceleration and deceleration instructions. Through the USB port, you can easily configure the driver and expand the application of the driver.

1.1 Characteristic

- Programmable small size stepper motor driver
- Working voltage: 24 ~ 48V DC
- Communication method: USB to COM
- Maximum phase current output: 5.6A / phase (sinusoidal peak value)
- Low-speed vibration harmonic algorithm, which greatly optimizes the specific low-speed vibration of the motor
- Phase loss alarm function
- Digital IO port:

  3 optically isolated digital signal inputs, high level can directly receive 24V DC level;

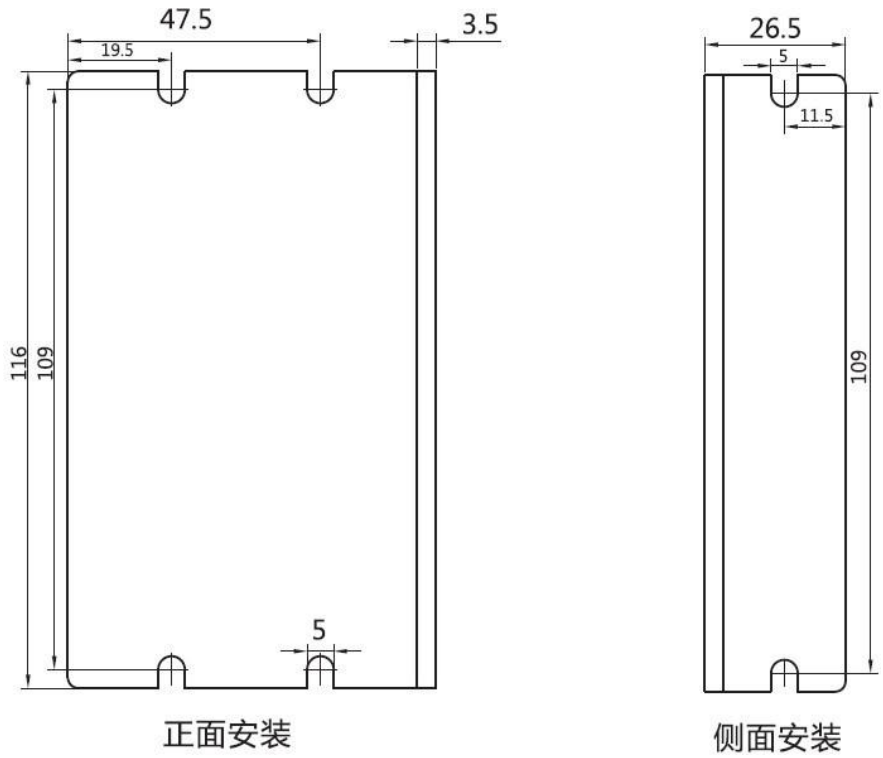
  1 optically isolated digital signal output, maximum withstand voltage 30V, maximum sink or draw current 50mA.
- 8 levels of user-definable current
- 16 levels of user-defined subdivisions, supporting any resolution in the range of 200 ~ 65535
- IO control mode, support 16 speed customization
- Programmable input port and output port

2. Application Environment and Installation

2.1 Environmental requirement

Item	R60-AL
Installation Environment	Avoid dust, oil and corrosive environment
Vibration	0.5G （4.9m/s2） Max
Operating temperature/humidity	0℃ ~ 45℃ / 90% RH or less (no condensation)
Storage and transportation temperature:	-10 ℃ ~ 70 ℃
Cooling	Natural cooling / away from the heat source
Waterproof grade	IP54

2. 2 Drive installation dimensions



3. Drive Port and Connection

3. 1 Port function description

Function	Grade	Definition	Remarks
Motor	B-	Two-phase stepping motor B-phase winding	Reversing any set of windings will change the running direction of the motor
	B+		
	A-	Two-phase stepping motor A-phase winding	
	A+		
Power supply	V+	Positive pole of power supply	Pls do not connect reverse the power
	V-	Negative pole of power supply	

3.1.1 Power input

The driver's working power is DC power, and the input voltage range is between 18V ~ 50V.

Power selection reference:

Voltage:

The stepping motor has the characteristic that the torque decreases with the increase of the motor speed, and the input power voltage will affect the magnitude of the high-speed torque drop of the motor. Properly increasing the voltage of the input power can increase the output

torque of the motor at high speed.

Stepping servo has higher speed and torque output than ordinary stepping. Therefore, if better high-speed performance is desired, the power supply voltage of the driver needs to be increased.

Current:

The driver works by converting the input high-voltage and low-current power supply to the low-voltage and high-current across the motor windings. In actual use, select a suitable power source according to the motor model, load torque and other factors.

Effect of regeneration voltage:

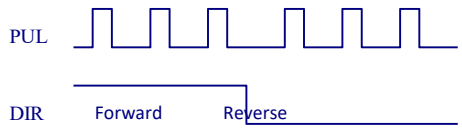
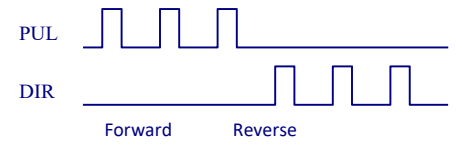
The stepper motor also retains the characteristics of the generator when it is working. During deceleration, the kinetic energy accumulated by the load will be converted into electrical energy and superimposed on the driver circuit and input power. When using, pay attention to the setting of acceleration and deceleration time to prevent the protection of the driver or power supply. When the drive is powered off, when the load is pulled to make the motor move, you will see that the drive LED is on, which is also affected by this.

3.2 Control signal connection

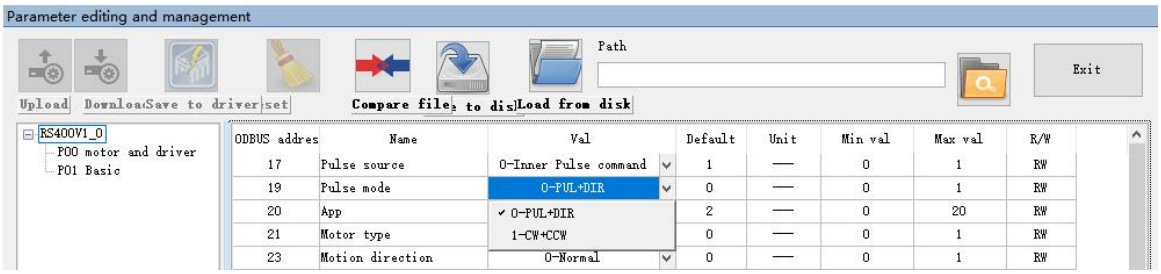
Function	Grade	Description
Pulse/IN1	PUL+	Receive 24V signal by default, please use -5V for 5V signal
	PUL-	
Direction/IN2	DIR+	
	DIR-	
Enable/IN3	ENA+	
	ENA-	
Alarm/OUT1	ALM+	Photocoupler isolation, open collector output
	ALM-	

3.2.1 PUL、DIR(IN1，IN2) port：

When working in external pulse command mode by default, R60-AL can receive two pulse command signals: PUL + DIR, CW + CCW.

脉冲&方向（PUL + DIR）	
双脉冲（CW +CCW）	

External pulse command form through debugging software



3.2.2 ENA（IN3）port:

The default ENA port is the drive offline (enabled) function:

When the internal photocoupler is turned off, the driver outputs current to the motor;

When the internal photocoupler is turned on, the driver will cut off the current of each phase of the motor to make the motor in a free state. At this time, the step pulse is not responded.

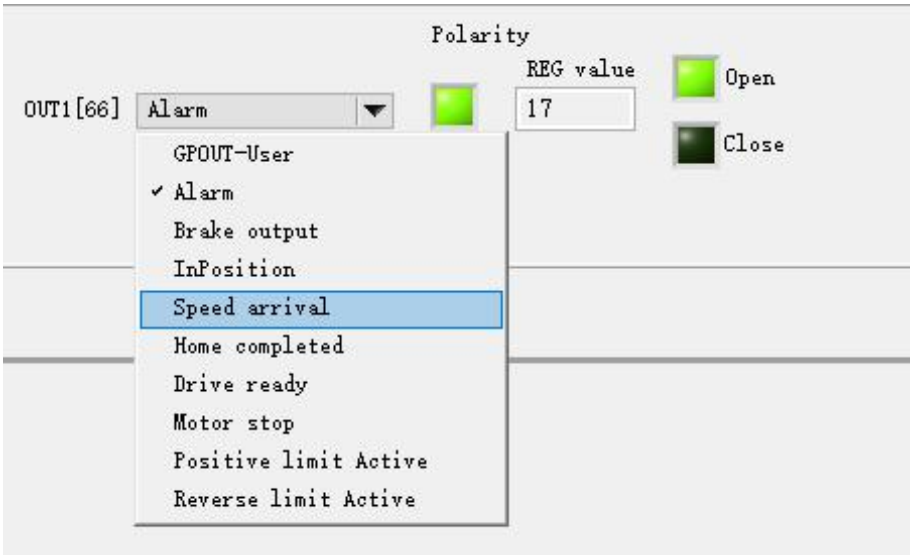
When the motor is in an error state, the enable is automatically disconnected.

The level logic of the enable signal can be set to the opposite.

At the same time, this port can be multiplexed with other functions like IN1 and IN2.

3.2.3 ALM（OUT1）port:

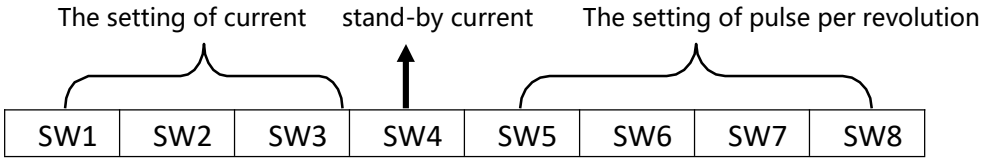
The driver includes an optically isolated output port ALM. By default, the ALM port is an alarm output. When the driver is in an error state and a normal working state, the ALM outputs different optocoupler levels.
At the same time, it can be reused for other functions, as shown below:



3.3 USB port

The USB is a micro usb portand a USB driver needs to be installed.

4. The setting of DIP switches and operating parameters



4. 1 The setting of current

Current	SW1	SW2	SW3	Remarks
1.4	on	on	on	8 levels of current can be set by the debugging software
2.1	off	on	on	
2.7	on	off	on	
3.2	off	off	on	
3.8	on	on	off	
4.3	off	on	off	
4.9	on	off	off	
5.6	off	off	off	

4. 2 Stand-by current

SW4 is used to set the current percentage when the driver is in standby,

SW4 = ON, as long as the driver is in the enabled state, the current remains at the set current

SW4 = OFF, after the driver stops receiving pulses for a certain period of time, it enters the standby state, and the current drops to a certain percentage of the set current

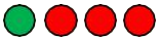
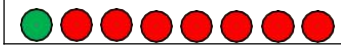
The default setting is: After stopping receiving pulses for 1 second, the motor winding current will be 50%.

4. 3 The setting of pulse per revolution

Stepping count/revolution	SW5	SW6	SW7	SW8	Remarks
200	on	on	on	on	16 levels of subdivision can be set through the debugging software
400	off	on	on	on	
800	on	off	on	on	
1600	off	off	on	on	
3200	on	on	off	on	
6400	off	on	off	on	
12800	on	off	off	on	
25600	off	off	off	on	
1000	on	on	on	off	
2000	off	on	on	off	

4000	on	off	on	off	
5000	off	off	on	off	
8000	on	on	off	off	
10000	off	on	off	off	
20000	on	off	off	off	
25000	off	off	off	off	

5. Drive working status LED indication

LED status		Drive status
	Green indicator is on for long time	Drive not enabled
	Green indicator is flickering	Drive working normally
	One green and one red indicator	Drive overcurrent
	One green and two red indicators	Drive input power overvoltage
	One green and three red indicators	The internal voltage of the drive is wrong
	One green and seven red indicators	Motor phase loss

6. Low speed vibration

Aiming at the resonance problem of two-phase stepper motors in the low speed region, R60-AL uses a harmonic algorithm to effectively reduce the resonance of the motor.

Generally, the first resonance point speed V1 of a two-phase stepping motor is around 1 rps, and the second resonance point speed V2 is around 2 rps. The specific resonance speed of the motor is directly related to the inertia and current of the motor. It needs to be tested to find the resonance point under different conditions.

The velocity relationship between the two resonance points is as follows:

$$V2 = 2 \times V1$$

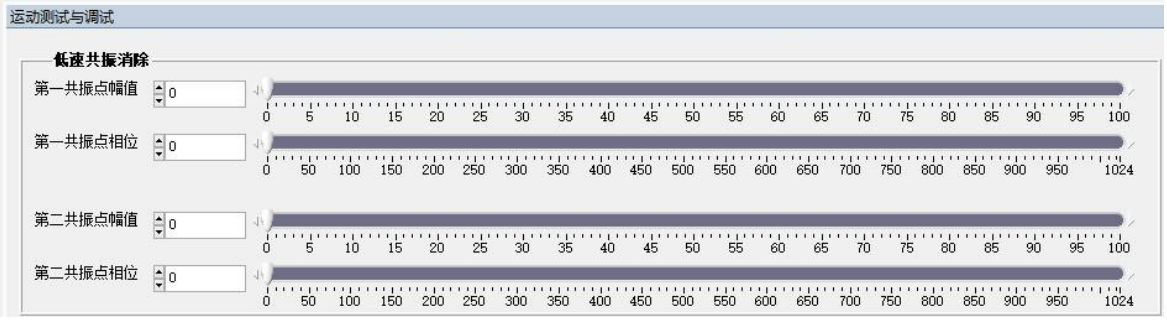
To debug resonance,

In the first step, you need to find the resonance point. You can use an external pulse or an internal pulse to find the first resonance point by comparison, and then maintain the current speed.

The second step is to adjust the amplitude and phase of the first resonance point, and the resonance of the motor will be significantly reduced.

The third step is to let the motor run at the second resonance point and maintain the current speed.

The fourth step is to adjust the amplitude and phase of the second resonance point. The resonance of the motor will be significantly reduced. The debugging interface is as follows:



7. Phase loss alarm

The driver has a motor phase loss alarm function, which can detect the phase loss state that occurs when the motor is stationary and in motion. During the operation of the stepper motor, due to mechanical reasons, the motor winding wire may be loosened and disconnected. At this time, the driver will output an alarm signal to prevent the device from making wrong actions.

Because this function depends on the current detection of the motor winding, when the motor current is too small (less than 300mA), this function has a false alarm. At this time, the user can turn off this function. Set parameter 188: Phase loss detection enable, set it to 0.

8. Internal motion control function

When working in the internal pulse command mode, the PUL and DIR ports are used as IO input signals. The IO functions need to be set through the debugging software RStepper Configurator. As shown below:

8.1 Communication control mode

In this mode, the user can make the motor run the specified pulse stroke or jog operation by communicating with the given running command. Specific instructions are as follows:

8.1.1 Point control mode

It has the function of communication control motor running the specified pulse stroke. The specific modes and parameters that need to be set are as follows (the register address is a decimal number unless otherwise noted or described):

(1) Set the register address 20 (selected by the preset application program in the internal pulse mode) to 0 (communication control, respond to the instruction of register address 18);

(2) Set the functions of the digital input and output ports according to the application needs and the actual wiring terminals;

(3) Set motion parameters:

Address	Unit	Parameter Description
70	R/S^2	Acceleration of point motion
71	R/S^2	Deceleration of point motion
72	RPM	Speed of point motion
73	Command pulse	Low 16-bit register of instruction pulse for point motion
74	Command pulse	High 16-bit register of instruction pulse for point motion
78	R/S^2	Emergency stop deceleration
84	-	Set position operation mode:

0	Incremental
1	Absolute

(4) Communication given operation instruction: Start the point movement by writing the values 1 (fixed length forward rotation) and 2 (fixed length reverse rotation) to register 18 (for details of this register, please refer to "Drive Control Mode" Set register 18 in [17 ~ 23] ” ;

(5) During operation, if stopping is required, you can write value 6 (deceleration stop, deceleration is set value of register 71), value 5 (emergency stop stop, deceleration is set value of register 78) into register .

Note:

When the motor is running, it only responds to the stop command (deceleration stop or emergency stop). If you need to change the running direction of the motor by command, you need to send a stop command and wait for the motor to stop before sending a start signal in the other direction.

Change the acceleration (register 70), deceleration (register 71), and speed (register 72) during the motor running, but the driver will not respond to these settings immediately. The setting will only be set after the motor is stopped and restarted Value to run. It is important to point out that the emergency stop deceleration (Register 78) is responded to the emergency stop of the current motion, and there is no need to wait for the emergency stop of the next motion.

8.1.2 Jog control mode

It has the function of controlling the jog operation of the motor through communication. The specific modes and parameters that need to be set are as follows (the register address is a decimal number unless otherwise noted or described):

(1) Set the value of register address 20 (selected by the preset application program in internal pulse mode) to 0 (communication control, respond to the instruction of register address 18);

(2) Set the functions of the digital input and output ports according to the application needs and the actual wiring terminals;

(3) Set motion parameters:

Address	Unit	Parameter Description
75	R/S^2	Acceleration of point motion
76	R/S^2	Deceleration of point motion
77	RPM	Speed of point motion
78	R/S^2	Emergency stop deceleration

(4) Communication given operation instruction: Start the point motion by writing the values 3 (continuous forward rotation) and 4 (continuous reverse rotation) to register 18 (for details of this register, please refer to "Drive Control Mode Setting [17 to 23] "in register 18);

(5) During operation, if stopping is required, you can write value 6 (deceleration stop, deceleration to register 76 setting value) and value 5 (emergency stop stop, deceleration to register 78 setting value) to register 18 .

Note:

When the motor is running, it only responds to the stop command (deceleration stop or emergency stop). If you need to change the running direction of the motor by command, you need to send a stop command and wait for the motor to stop before sending a start signal in the other direction.

The acceleration (register 75) and deceleration (register 76) are changed during the running of the motor, but the driver will not respond to these set values immediately. The motor will run at the set values only after the motor is stopped and started again. It is important to point out that the emergency stop deceleration (Register 78) is responded to the emergency stop of the current motion, and there is no need to wait for the emergency

stop of the next motion.

The speed can be changed during the running of the motor (register 77), and the driver will respond immediately, that is, the motor will immediately run at the set speed value, without the need to restart after stopping to respond.

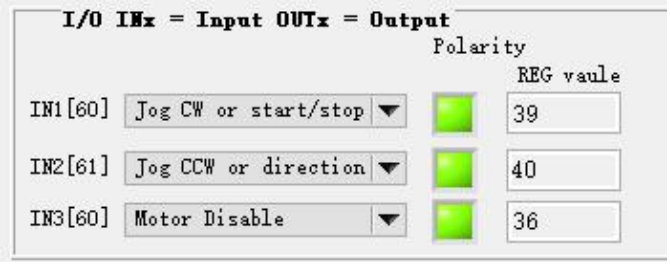
8.2 IO control: start / stop + direction

In this mode, two IN ports are used to control the operation of the motor. One of the IN terminals is used to control the start / stop of the motor, and one IN terminal is used to control the running direction of the motor. The specific settings are as follows:

(1) Command working mode: 0-internal pulse mode

(2) Internal application mode: 2-IO speed control: start / stop + direction

(3) IO settings：



(4) The speed for this mode is the speed defined by the speedometer, selected by SW5, 6, 7, 8

(5) Set motion parameters, you can modify acceleration and deceleration

8.3 IO control: forward + reverse

Same as 8.2, only need to modify (2) to: 3-IO speed control: forward + reverse.

9. Common Faults and Troubleshooting

Phenomenon	Possible situations	Solutions
Motor does not work	Power indicator is off	Check the power supply circuit for normal power supply
	The motor rotor is locked but the motor does not work	Pulse signal is weak; increase the signal current to 7-16mA
	The speed is too slow	Select the right micro-stepping
	Drive is protected	Solve the alarm and re-power
	Enable signal problem	Pull up or disconnect the enable signal
	Command pulse is incorrect	Check whether the upper computer has pulse output
The steering of motor is wrong	The rotary direction of motor is reverse	Adjust motor wiring, or change direction with software
	The motor cable is disconnected	Check the connection
	The motor has only one direction	Pulse mode error or DIR port damaged
Alarm indicator is on	The motor connection is wrong	Check the motor connection
	The voltage is too high or too low	Check the power supply
The position or speed is wrong	The signal is disturbed	Eliminate interference for reliable grounding
	The command input is incorrect	Check the upper computer instructions to ensure the output is correct
	The setting of Pulse per revolution is wrong	Check the DIP switch status and correctly connect the switches
The drive terminal burned up	Short circuit between terminals	Check power polarity or external short circuit
	Internal resistance between terminals is too large	Check whether there is any solder ball due to excessive addition of solder on the wire connections